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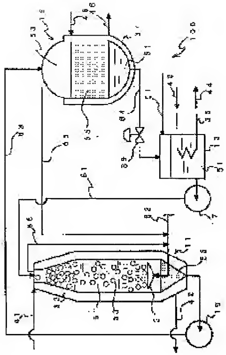
(54) APPARATUS AND METHOD FOR PRODUCING GAS HYDRATE BY GAS-LIQUID COUNTERCURRENT SYSTEM



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a gas hydrate production apparatus and its production method which enable efficient formation of a gas hydrate by prolonging the gas-liquid contact time within a formation tank.
SOLUTION: The gas hydrate production apparatus 100 for forming a gas hydrate 55 by reacting water 51 with a gas 53 comprises a longitudinal nearly cylindrical formation tank 11 for forming a gas hydrate 55 under a predetermined pressure and at a predetermined temperature, a water supply pump 17 for continuously introducing water from the top of the formation vessel, a gas diffusion mechanism 31 which introduces the gas in the form of bubbles from the lower part of the above formation tank, and a water discharge means 19 to continuously discharge water from the bottom of the formation tank, and the gas hydrate 55 is produced so as to form a water flow countercurrently to the bubbles rising by buoyancy by continuously supplying water 51 into the formation tank 11 and, simultaneously, discharging water.

CLAIMS

[Claim(s)]

[Claim 1]A generation tub which is a gas-hydrate manufacturing installation which makes water and gas react and makes gas-hydrate generate, and makes gas-hydrate generate under specified pressure and prescribed temperature, A water supplying means for introducing water into this generation tub, and a gas supply means which introduces gas into water in said generation tub as air bubbles, By having a water ejecting means for

discharging water from said generation tub, and a gas-hydrate ejecting means for discharging gas-hydrate generated within said generation tub, and supplying and discharging water in said generation tub, A manufacturing installation of gas-hydrate forming air bubbles which go up underwater with lift, and a stream which counters.

[Claim 2]A manufacturing installation of gas-hydrate which said water ejecting means and said gas-hydrate ejecting means are provided in one in claim 1, and is characterized by being what discharges gas-hydrate with water.

[Claim 3]A manufacturing installation of gas-hydrate, wherein said generation tub has a cellular stagnation facilitator which extends gas-liquid contact time by urging stagnation of air bubbles in claim 1 or 2.

[Claim 4]A manufacturing installation of gas-hydrate which is what resembles a wall inclined so that said cellular stagnation facilitator might turn caudad and might be extended in claim 3 from a narrow diameter portion which was established in said generation tub, and where an inside diameter is short, and this narrow diameter portion, and is constituted more.

[Claim 5]Any 1 paragraph of claim 1 to claim 4 characterized by comprising the following.
A water cycle means to circulate water of aqueous phase separated within this tank into said generation tub via said water supplying means while having further a tank which stores gas-hydrate discharged by said gas-hydrate ejecting means from a generation tub.
A gas circulation means which collects gas which surfaced inside of said generation tub, and/or gas in said tank, and is circulated into said generation tub via said gas supply means.

[Claim 6]While carrying out aeration of the material gas to water in a generation tub which is a manufacturing method of gas-hydrate which makes water and gas react under application of pressure, and makes gas-hydrate generate, and makes gas-hydrate generate, considering it as air bubbles and surfacing underwater, A manufacturing method of gas-hydrate forming a stream which counters said air bubbles which surface.

[Claim 7]A manufacturing method of gas-hydrate which makes generated gas-hydrate accumulate according to said stream in claim 6, and is characterized by making it take out out of a tub.

[Claim 8]A manufacturing method of gas-hydrate promoting stagnation of air bubbles in a generation tub in claim 6 or 7 by a cellular stagnation facilitator formed in said generation tub.

[Claim 9]A manufacturing method of gas-hydrate controlling the rate of flow of a cell diameter and water in any 1 paragraph of claims 6-8 so that air bubbles carry out predetermined time stagnation into a generation tub.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]
[Field of the Invention]This invention relates to the device and manufacturing method which manufacture gas-hydrate from natural gas, methane, carbon dioxide, etc.

[0002]
[Description of the Prior Art]Gas-hydrate is solid matter of the shape of ice which consists of a water molecule and a gas molecule.
It is a hydrate of the structure which incorporated the gas molecule into the inside of the cage structure formed of a water molecule.
Since this gas-hydrate has character, such as high gas concealment nature, big generation and heat of dissociation, generation / dissociation differential pressure, high reaction selectivity, use for various uses, such as transportation and storage means, such as natural gas, and separate recovery of a thermal storage system, an actuator, and gas, attracts attention, for example.
Research is done.

[0003]Conventionally, it was filled up with water in the generation tub, it cooled to the temperature of about 1-5 **, and material gas, such as natural gas, was filled up with manufacture of gas-hydrate there, and 2.8-4.2 or more MPa was pressurized, and it was manufacturing. In order to make the touch area of the gas within a generation tub, and water increase in this method, Pump suction of the gas of a generation tub gas phase portion was carried out, aeration was carried out from the lower part of the liquid phase, or the agitator which provided the gas stream passage which is open for free passage from the axis of rotation to wings was used, and methods, such as carrying out aeration from a self-priming **** wing tip according to the centrifugal force of the wings turning around the gas of a generation tub gas phase portion, were adopted.

[0004]However, in these methods, in order for the air bubbles of the gas emitted into the liquid phase to surface a liquid phase part for a short time and to escape from them to a gas phase portion, the contact time of vapor-liquid could not but become short. Since the generation rate of gas-hydrate was influenced by the dissolved amount of the gas to the inside of liquid, the amount of solution gas was restricted by that the contact time of vapor-liquid is short, and it had the problem that the production efficiency of gas-hydrate became low. Of course, if a generation tub is enlarged, it is possible to lengthen holding time of the air bubbles which go up the inside of the liquid phase in a generation tub to some extent, but the simple enlargement cannot become realistic solution from restrictions of the installing space of a device, etc.

[0005]On the other hand, in JP,2000-264851,A. While supplying a hydrate morphogenetic substance to the aqueous phase in a hydrate generation container as air

bubbles, the manufacturing method of the hydrate making a hydration reaction cause is proposed by carrying out the spray of the water to the gaseous phase in said hydrate generation container at spray form. Since the air bubbles of the hydrate morphogenetic substance in the aqueous phase surface like conventional technology shown above for a short time and are diffused from the aqueous-phase surface in this method, The contact time of vapor-liquid is short, by the gaseous phase, so, the spray of the water is separately carried out to the gaseous phase from the upper part of a hydrate generation container, a hydrate generation reaction must be performed, and a complicated equipment configuration is not avoided, either.

[0006]Therefore, without having enlarged the device or complicating, the contact time of the vapor-liquid within a generation tub was increased, and a means to manufacture gas-hydrate efficiently was desired.

[0007]

[Problem(s) to be Solved by the Invention]The technical problem of this invention is providing the manufacturing installation and manufacturing method of gas-hydrate with possible lengthening gas-liquid contact time within a generation tub, and making gas-hydrate generate efficiently.

[0008]

[Means for Solving the Problem]In order to solve an aforementioned problem, an invention of a manufacturing installation of the gas-hydrate according to claim 1, A generation tub which is a gas-hydrate manufacturing installation which makes water and gas react and makes gas-hydrate generate, and makes gas-hydrate generate under specified pressure and prescribed temperature, A water supplying means for introducing water into this generation tub, and a gas supply means which introduces gas into water in said generation tub as air bubbles, By having a water ejecting means for discharging water from said generation tub, and a gas-hydrate ejecting means for discharging gas-hydrate generated within said generation tub, and supplying and discharging water in said generation tub, Air bubbles which go up underwater with lift, and a stream which counters were formed.

[0009]Since air bubbles which go up underwater with lift, and a stream which counters were formed according to this feature, introducing gas into a generation tub as air bubbles, It can become possible to make air bubbles stagnate in a generation tub, and to extend gas-liquid contact time, a dissolved amount of underwater material gas can be raised, and a generated amount of gas-hydrate can be made to increase substantially. And since it is a method using a stream which counters air bubbles, gas-liquid contact time can be increased, without enlarging a device or forming devices, such as a sprayer style of water, and also regulation of gas-liquid contact time can also be performed easily. Since continuous running in a high gas-hydrate generated amount is possible, it is possible to manufacture gas-hydrate very efficiently. A method of introducing water into a generation tub continuously, and discharging water continuously from a generation tub as a desirable example of a method of forming air bubbles and a stream which counters in a generation tub, can be mentioned. In this case, as for water, it is preferred to introduce

from a crowning or near a crowning a generation tub, and to discharge from a pars basilaris ossis occipitalis or near a pars basilaris ossis occipitalis a generation tub. If this method is adopted, while being able to form easily a stream which descends inside of a generation tub, it becomes easy by adjusting strength of a stream to control not to make air bubbles reach to a crowning of a generation tub. Therefore, sufficient gas-liquid contact time by stagnation of air bubbles is securable, and also a mechanism for recovery of gas in a generation tub crowning or circulation can be made simple, or it can omit. Although an entry site in particular of air bubbles is not limited, in order to increase gas-liquid contact using climbing power of air bubbles, introducing from the lower part of a generation tub is preferred.

[0010]In claim 1, said water ejecting means and said gas-hydrate ejecting means are provided in one, and an invention of a manufacturing installation of the gas-hydrate according to claim 2 is characterized by being what discharges gas-hydrate with water. Since it had composition which shares a water ejecting means and a gas-hydrate ejecting means according to this feature, gas-hydrate is easily recoverable in the state of a slurry by making gas-hydrate discharge using a stream. Simplification of a device can be attained by considering it as a mechanism which shares a gas-hydrate ejecting means and a water ejecting means. In this case, since extraction of generated gas-hydrate will become smooth if it has composition made to discharge from a pars basilaris ossis occipitalis or near a pars basilaris ossis occipitalis a generation tub, it is much more efficient.

[0011]An invention of a manufacturing installation of the gas-hydrate according to claim 3 has a cellular stagnation facilitator which extends gas-liquid contact time by urging stagnation of air bubbles to said generation tub in claim 1 or 2. Since contact time of vapor-liquid can be extended by a cellular stagnation facilitator according to this feature, gas-hydrate can be manufactured at higher efficiency. Here, a baffle etc. which establish a narrow diameter portion and an inclined wall which carry out a postscript as a cellular stagnation facilitator and which do not block a stream remarkably can be used.
[0012]An invention of a manufacturing installation of the gas-hydrate according to claim 4 is characterized by being what resembles a wall inclined so that said cellular stagnation facilitator might turn caudad and might be extended from a narrow diameter portion which was established in said generation tub, and where an inside diameter is short, and this narrow diameter portion, and is constituted more in claim 3. By adopting a narrow diameter portion where an inside diameter is short, and a wall inclined so that it might turn caudad and might be extended from a narrow diameter portion as a cellular stagnation facilitator according to this feature, It becomes possible to suppress a rise of air bubbles and to promote stagnation, without barring a stream which air bubbles which went up will stagnate in a narrow space surrounded by inclined wall, and flows down inside of a tub as a result of the rate of flow in a narrow diameter portion becoming quick. and this cellular stagnation facilitator -- structure -- it is not necessary to simplify and to complicate an equipment configuration Although it is preferred to provide a narrow diameter portion near the crowning of a generation tub as a position which forms a cellular stagnation facilitator, unless a stream in a generation tub is barred, it is also possible to provide in other parts (it is near the central part of a long generation tub to

length), and to provide in two or more parts in one generation tub.

[0013]An invention of a manufacturing installation of the gas-hydrate according to claim 5, While having further a tank which stores gas-hydrate discharged by said gas-hydrate ejecting means from a generation tub in any 1 paragraph of claim 1 to claim 4, A water cycle means to circulate water of aqueous phase separated within this tank into said generation tub via said water supplying means, gas which surfaced inside of said generation tub, and/or gas in said tank were collected, and a gas circulation means circulated into said generation tub via said gas supply means was formed. According to this feature, continuous operation is attained by having formed a gas circulation means to collect and circulate from a tank a water cycle means circulated into a generation tub, gas which surfaced inside of a generation tub, and/or gas in a tank, using effectively water and gas used as a raw material of gas-hydrate.

[0014]An invention of a manufacturing method of the gas-hydrate according to claim 6, While carrying out aeration of the material gas to water in a generation tub which is a manufacturing method of gas-hydrate which makes water and gas react under application of pressure, and makes gas-hydrate generate, and makes gas-hydrate generate, considering it as air bubbles and surfacing underwater, A stream which counters said air bubbles which surface was formed. According to this feature, the same operation effect as above-mentioned claim 1 is obtained. That is, it can become possible to make air bubbles stagnate in a generation tub, and to extend gas-liquid contact time, a dissolved amount of underwater material gas can be raised, and a generated amount of gas-hydrate can be made to increase substantially. And since it is the method of using a stream which counters air bubbles, gas-liquid contact time can be increased, without enlarging a device or forming devices, such as a sprayer style of water, and also regulation of gas-liquid contact time can also be performed easily. Since continuous running in a high gas-hydrate generated amount is possible, it is possible to manufacture gas-hydrate very efficiently.

[0015]In claim 6, an invention of a manufacturing method of the gas-hydrate according to claim 7 makes it accumulated according to said stream, and took out generated gas-hydrate out of a tub. Since according to this feature you make it accumulated using a stream and generated gas-hydrate was taken out out of a tub, while recovery of gas-hydrate becomes easy, gas-hydrate is recoverable by high concentration.

[0016]An invention of a manufacturing method of the gas-hydrate according to claim 8 promoted stagnation of air bubbles in a generation tub in claim 6 or 7 by a cellular stagnation facilitator formed in said generation tub. According to this feature, the same operation effect as above-mentioned claim 3 is obtained. Here, a baffle etc. can be used in the range which does not bar a stream in a generation tub besides the narrow diameter portion same as a cellular stagnation facilitator as what was indicated to above-mentioned claim 4, and an inclined wall.

[0017]In any 1 paragraph of claims 6-8, an invention of a manufacturing method of the gas-hydrate according to claim 9 controls the rate of flow of a cell diameter and water so that air bubbles carry out predetermined time stagnation into a generation tub. According

to this feature, when the rate of flow of a cell diameter and water is controlled and air bubbles were made to carry out predetermined time stagnation into a generation tub, without enlarging a generation tub, sufficient gas-liquid contact time is secured and gas-hydrate can be manufactured efficiently. It becomes possible by adjusting holding time of air bubbles suitably to control particle diameter of gas-hydrate to generate in a desired size. Especially if holding time of air bubbles in a generation tub is time for gas-hydrate to fully generate, it is not limited, but it can be set up in about 1 to 10 minutes preferably 1 minute or more, for example.

[0018]
[Embodiment of the Invention]Hereafter, based on a drawing, this invention is explained in more detail. Drawing 1 is a drawing in which the outline of the gas-hydrate manufacturing installation 100 which is one embodiment of this invention is shown. This gas-hydrate manufacturing installation 100 is a continuous system manufacturing installation of gas-hydrate which has the generation tub 11, the water tank 13, the gas-hydrate tank 15, the water supply pump 17, and the extraction pump 19 as main composition. The kind of gas used as a raw material will not be limited especially if gas-hydrate is formed by predetermined pressure and temperature conditions, for example, it can mention methane, natural gas (mixed gas, such as methane, ethane, propane, and butane), carbon dioxide (carbon dioxide), etc.

[0019]Whole shape was carrying out longwise outline tubed, the crowning was equipped with the introduction means of water, and the generation tub 11 to which a gas-hydrate generation reaction is performed equipped the pars basilaris ossis occipitalis with the ejecting means of water, and is provided with the aeration mechanism 31 which emits the gas 53 to the lower part as air bubbles further. This generation tub 11 is the resisting pressure container provided with the jacket type heat exchanger 33 as a cooling method, flows out with the inflow 41 of brine, cools internal water and gas by 42, and it is constituted so that the temperature and the pressure in a tub can be maintained in the state of having been suitable for the generation condition of gas-hydrate. Although the generation tub 11 is equipped with the jacket type heat exchanger 33 as a cooling method in drawing 1, When maintainable to the temperature which needs the inside of the generation tub 11 for gas-hydrate generation, For example, the water 51 is cooled and supplied from the water tank 13 provided with the cooling method (coil type heat exchange mechanism 35) to a temperature required for generation of gas-hydrate, And it is not necessary to prepare said jacket type heat exchanger 33 for a case so that it may flow out of the inside of the generation tub 11 comparatively for a short time at the generation tub 11.

[0020]Drawing 2 is a drawing in which an example of the shape of the generation tub 11 is shown, and after [expedient] explaining here, it has expanded and indicated breadth. As for the whole shape of the generation tub 11, it is preferred to use the shape of a longwise approximately cartridge so that it may illustrate to drawing 2. It not only becomes easy to secure gas-liquid contact time, but by making the generation tub 11 into long picture shape perpendicularly, it becomes easy to make a uniform stream form in the generation tub 11. Namely, in order to suppress a motion to the horizontal direction of the

air bubbles which go up the inside of the generation tub 11 as much as possible (getting it blocked and making horizontal cellular distribution uniform) and to control a motion of the perpendicular direction further, it becomes important to form a uniform stream in the generation tub 11, but. It is because it becomes easy to realize a uniform stream by making the generation tub 11 into the shape of a longwise cartridge. But if formation of a stream uniform in the generation tub 11 is possible, it is also possible to adopt other shape.

[0021]The cellular stagnation part 112 of predetermined length with the wall inclined so that this generation tub 11 might be extended caudad towards near a crowning from the short narrow diameter portion 111 and this narrow diameter portion 111 of an inside diameter, The major diameter 113 caudad formed in tubed with predetermined length from the lower end of this cellular stagnation part 112, the gas-hydrate accumulation part 114 of the predetermined length inclined so that it might strangulate toward a pars basilaris ossis occipitalis from the lower end of this major diameter 113, and **, ** and others As a result of the rate's of flow becoming quick by using such shape compared with the major diameter 113 in the narrow narrow diameter portion 111 and the cellular stagnation part 112 of an inside diameter, it becomes possible to block passage of the air bubbles which gather as it rises to surface, and a climbing speed increases, and to secure sufficient holding time. That is, the wall in which the narrow diameter portion 111 and the cellular stagnation part 112 inclined functions as a cellular stagnation facilitator for urging stagnation of air bubbles and lengthening gas-liquid contact time. A cellular stagnation facilitator will not be restricted to the above-mentioned composition, if the holding time of air bubbles can be extended without barring the stream which flows down the inside of the generation tub 11.

[0022]In order to obtain the uniform stream in the generation tub 11, and diffusion of air bubbles, For example, the ratio (ratio of length to diameter) of the inside diameter (D) of the major diameter 113 and the length (L) from the aeration part (aeration mechanism 31) located in the lower end vicinity of the major diameter 113 to the upper bed of the major diameter 113 is made about into five to ten, It is preferred to set the ratio (l/d) of the inside diameter (d) of the narrow diameter portion 111 and the length (l) of the cellular stagnation part 112 about to ten to 20.

[0023]Drawing 3 is a drawing in which another example of the generation tub 11 is shown, and it can promote stagnation of air bubbles, securing diffusion of a uniform stream and air bubbles, even if it uses such shape.

[0024]Although a stirring means may be provided in the generation tub 11, even if it does not establish a stirring means, the water 51 and the gas 53 are fully mixed with aeration by the stirring effect by a stream. Therefore, it is possible to omit stirring power and manufacture with energy saving is realized.

[0025]The water tank 13, the water supply pump 17, and the water supply piping 61 constitute the water supplying means, and they introduce it continuously to the generation tub 11, pressurizing the water 51 to specified pressure. Since it is provided with the coil-

in-box cooler 35, the water tank 13 can cool beforehand the water 51 which flows out with the inflow 43 of brine and is supplied to the generation tub 11 by 44 to prescribed temperature, prevents the rise in heat in the generation tub 11, and is raising the production efficiency of gas-hydrate. Since the water 51 cooled also when the circulation reuse of the water 51 from the gas-hydrate tank 15 was carried out so that it may mention later can be used, it is advantageous.

[0026]The gas-hydrate tank 15 is provided with the jacket type heat exchanger 37 for gas-hydrate incubation outside, and by cooling by the inflow 45 of brine, and the outflow 46, it is constituted so that the degree of tub internal temperature can be kept constant.

[0027]Although it is full of the water 51 introduced from the crowning of the generation tub 11 with specified pressure in a tub, it will flow down the inside of a tub by operating the extraction pump 19 as a water ejecting means, and discharging from a pars basilaris ossis occipitalis, forming the flow field of a predetermined speed. The flow of this water 51 is formed as the air bubbles which go up underwater by lift, and a flow which counters so that it may mention later. the horizontal section of the generation tub 11 -- mostly, in the whole, the water 51 is supplied so that this countercurrent flow may arise.

[0028]Although it is preferred to be able to adjust to a predetermined speed and to set up according to a cell diameter by introduction and the discharge of the water 51 as for the flowing-down speed of the water 51 in the generation tub 11, it can be made into the range of 0.1 - 3 m/s, for example.

[0029]The gas 53 is inserted into the generation tub 11 from the lower part of the generation tub 11 via the gas supplying pipelines 62 from the supply source which is not illustrated, and is underwater emitted as air bubbles from the aeration mechanism 31. Since the downward current of the prescribed speed is formed downward from the top so that air bubbles may be countered in a tub, the climbing speed of air bubbles becomes remarkably slow compared with the case where there is no downward current, or has a rise barred although the emitted air bubbles go up the inside of the generation tub 11 according to the climbing power. The gas in air bubbles follows on being consumed as a hydrate, and the lift of air bubbles also becomes small. As a result, the holding time within the generation tub 11 of air bubbles becomes long, the dissolved amount of the gas 53 increases, and the generation reaction (hydration reaction) of gas-hydrate advances efficiently. As for the holding time of air bubbles, although it changes according to the downward rate of flow of a cell diameter or water, in order to make sufficient gas-hydrate generation reaction perform, it is preferred to set up, as it has been about 1 to 10 minutes, for example. It is also possible by adjusting the holding time of these air bubbles to control the particle diameter of the gas-hydrate to generate in arbitrary sizes. For example, by making flowing-down speed of water quick and shortening holding time of the air bubbles within a generation tub, Growth time of gas-hydrate can be shortened, the hydrate of small particle diameter can be manufactured, or by making flowing-down speed of water late and lengthening holding time of the air bubbles within a generation tub conversely, growth time of gas-hydrate can be lengthened and the hydrate of large

particle diameter can be manufactured.

[0030]Although the gas 53 is based also on the flowing-down speed of water, or the size of air bubbles, most is discharged from the pars basilaris ossis occipitalis of the generation tub 11 with a stream, and it is moved to the gas-hydrate tank 15. When the gas 53 goes up the generation tub 11 and a crowning is reached, via the 1st piping 66 for gas circulation, again, from the gas supplying pipelines 62, it is introduced in the generation tub 11 and reuse is achieved. In order to discharge the efficient gas 53 from generation tub 11 crowning, a pump may be installed in the 1st piping 66 for gas circulation if needed.

[0031]According to contact, the predetermined pressure, and temperature conditions of the above gas 53 and the water 51, the gas-hydrate 55 generates within the generation tub 11. The generated gas-hydrate 55 has specific gravity (for example, methane hydrate 0.915 g/cm^3) smaller than water, properly speaking, there is also a thing with the character which surfaces underwater, but. Even in this case, in this invention manufacturing installation 100, the gas-hydrate accumulation part 114 (refer to drawing 2 and drawing 3) near a pars basilaris ossis occipitalis is automatically piled up according to the stream in the generation tub 11, being discharged by operation of the extraction pump 19 as which a role of a gas-hydrate ejecting means also serves with the water 51 from a pars basilaris ossis occipitalis -- the piping 63 for gas-hydrate recovery -- ****** -- having -- it is stored in the gas-hydrate tank 15. Thus, while simplification of a device is attained by leading the water 51 and the gas-hydrate 55 to the gas-hydrate tank 15 in the same course, the gas-hydrate 55 of a fluid high slurry regime can be manufactured continuously and at high speed. In this embodiment, in order to transport the water 51 and the gas-hydrate 55 in the same course, discharge from the generation tub 11 is performed from the same part of a pars basilaris ossis occipitalis, but it may discharge separately like a 2nd embodiment that carries out a postscript. The part which discharges the water 51 or the gas-hydrate 55 is a range which does not restrict to the pars basilaris ossis occipitalis of the generation tub 11, and does not spoil the effect of this invention, and the composition discharged from other parts is possible for it.

[0032]Within the gas-hydrate tank 15, since the gas-hydrate 55 and the water 51 which were generated separate in layers, the lower layer water 51 is again returned to the water supply tub 13 via the 1st piping 64 for water cycles by opening of the valve 39, and is reused. water -- ****** -- having -- **** -- when the gas-hydrate 55 decomposes, the gas 53 which stagnated in the upper part of the gas-hydrate tank 15 is returned and reused via the 2nd piping 65 for gas circulation by the piping 62 for gas supply. By this, continuous running of the gas-hydrate manufacturing installation 100 which used water and gas effectively becomes possible.

[0033]Drawing 4 is a drawing in which the outline composition of the gas-hydrate manufacturing installation 101 of a 2nd embodiment of this invention is shown, and has established separately the water ejecting means and the gas-hydrate ejecting means here.

[0034]Namely, the gas-hydrate 55 accumulated on the gas-hydrate accumulation part 114 (refer to drawing 2 and drawing 3) near a pars basilaris ossis occipitalis according to the stream in the generation tub 11, being discharged by operation of the extraction pump 19 from a flank -- the piping 63 for gas-hydrate recovery -- ****** -- having -- it is stored in the gas-hydrate tank 15. On the other hand, the water 51 which flowed down the inside of the generation tub 11 is discharged from the pars basilaris ossis occipitalis of the generation tub 11 from an outlet other than the outlet of the gas-hydrate 55, and a reuse loop is sent and carried out to the water tank 13 by the 2nd piping 67 for water cycles. Thus, while being able to store the gas-hydrate 55 of the state where concentration is comparatively high in the gas-hydrate tank 15 by transporting the generation gas-hydrate 55 and the water 51 by alternative pathway, Since the greater part of a lot of circulating water is performed via the 2nd piping 67 for water cycles that carries out direct continuation to the water tank 13, it is efficient. Since other composition in drawing 4 is the same as that of drawing 1, it gives the same numerals to the same composition, and omits explanation.

[0035]

[Effect of the Invention]According to this invention, it writes with the air bubbles which go up the inside of a generation tub, and the composition which forms the stream which counters, It can become possible to reduce the climbing speed of air bubbles, to make air bubbles stagnate underwater, and to extend gas-liquid contact time, the dissolved amount of underwater material gas can be made to be able to increase, and the generated amount of gas-hydrate can be increased substantially. And with the strength of a stream, the size of a cell diameter, etc., since gas-liquid contact time can be adjusted, device size can be set up comparatively freely, and it is not necessary for it not to be necessary to enlarge device size or in order to raise production efficiency, and to form complicated devices, such as a sprayer style of water. Since continuous running in a high gas-hydrate generated amount is possible, it is possible to manufacture gas-hydrate very efficiently.

TECHNICAL FIELD

[Field of the Invention]This invention relates to the device and manufacturing method which manufacture gas-hydrate from natural gas, methane, carbon dioxide, etc.

PRIOR ART

[Description of the Prior Art]Gas-hydrate is solid matter of the shape of ice which consists of a water molecule and a gas molecule.
It is a hydrate of the structure which incorporated the gas molecule into the inside of the cage structure formed of a water molecule.

Since this gas-hydrate has character, such as high gas concealment nature, big generation and heat of dissociation, generation / dissociation differential pressure, high reaction selectivity, use for various uses, such as transportation and storage means, such as natural gas, and separate recovery of a thermal storage system, an actuator, and gas, attracts attention, for example.
Research is done.

[0003]Conventionally, it was filled up with water in the generation tub, it cooled to the temperature of about 1-5 **, and material gas, such as natural gas, was filled up with manufacture of gas-hydrate there, and 2.8-4.2 or more MPa was pressurized, and it was manufacturing. In order to make the touch area of the gas within a generation tub, and water increase in this method, Pump suction of the gas of a generation tub gas phase portion was carried out, aeration was carried out from the lower part of the liquid phase, or the agitator which provided the gas stream passage which is open for free passage from the axis of rotation to wings was used, and methods, such as carrying out aeration from a self-priming **** wing tip according to the centrifugal force of the wings turning around the gas of a generation tub gas phase portion, were adopted.

[0004]However, in these methods, in order for the air bubbles of the gas emitted into the liquid phase to surface a liquid phase part for a short time and to escape from them to a gas phase portion, the contact time of vapor-liquid could not but become short. Since the generation rate of gas-hydrate was influenced by the dissolved amount of the gas to the inside of liquid, the amount of solution gas was restricted by that the contact time of vapor-liquid is short, and it had the problem that the production efficiency of gas-hydrate became low. Of course, if a generation tub is enlarged, it is possible to lengthen holding time of the air bubbles which go up the inside of the liquid phase in a generation tub to some extent, but the simple enlargement cannot become realistic solution from restrictions of the installing space of a device, etc.

[0005]On the other hand, in JP,2000-264851,A. While supplying a hydrate morphogenetic substance to the aqueous phase in a hydrate generation container as air bubbles, the manufacturing method of the hydrate making a hydration reaction cause is proposed by carrying out the spray of the water to the gaseous phase in said hydrate generation container at spray form. Since the air bubbles of the hydrate morphogenetic substance in the aqueous phase surface like conventional technology shown above for a short time and are diffused from the aqueous-phase surface in this method, The contact time of vapor-liquid is short, by the gaseous phase, so, the spray of the water is separately carried out to the gaseous phase from the upper part of a hydrate generation container, a hydrate generation reaction must be performed, and a complicated equipment configuration is not avoided, either.

[0006]Therefore, without having enlarged the device or complicating, the contact time of the vapor-liquid within a generation tub was increased, and a means to manufacture gas-hydrate efficiently was desired.

EFFECT OF THE INVENTION

[Effect of the Invention]According to this invention, it writes with the air bubbles which go up the inside of a generation tub, and the composition which forms the stream which counters, It can become possible to reduce the climbing speed of air bubbles, to make air bubbles stagnate underwater, and to extend gas-liquid contact time, the dissolved amount of underwater material gas can be made to be able to increase, and the generated amount of gas-hydrate can be increased substantially. And with the strength of a stream, the size of a cell diameter, etc., since gas-liquid contact time can be adjusted, device size can be set up comparatively freely, and it is not necessary for it not to be necessary to enlarge device size or in order to raise production efficiency, and to form complicated devices, such as a sprayer style of water. Since continuous running in a high gas-hydrate generated amount is possible, it is possible to manufacture gas-hydrate very efficiently.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]The technical problem of this invention is providing the manufacturing installation and manufacturing method of gas-hydrate with possible lengthening gas-liquid contact time within a generation tub, and making gas-hydrate generate efficiently.

MEANS

[Means for Solving the Problem]In order to solve an aforementioned problem, an invention of a manufacturing installation of the gas-hydrate according to claim 1, A generation tub which is a gas-hydrate manufacturing installation which makes water and gas react and makes gas-hydrate generate, and makes gas-hydrate generate under specified pressure and prescribed temperature, A water supplying means for introducing water into this generation tub, and a gas supply means which introduces gas into water in said generation tub as air bubbles, By having a water ejecting means for discharging water from said generation tub, and a gas-hydrate ejecting means for discharging gas-hydrate generated within said generation tub, and supplying and discharging water in said generation tub, Air bubbles which go up underwater with lift, and a stream which counters were formed.

[0009]Since air bubbles which go up underwater with lift, and a stream which counters were formed according to this feature, introducing gas into a generation tub as air bubbles, It can become possible to make air bubbles stagnate in a generation tub, and to

extend gas-liquid contact time, a dissolved amount of underwater material gas can be raised, and a generated amount of gas-hydrate can be made to increase substantially. And since it is a method using a stream which counters air bubbles, gas-liquid contact time can be increased, without enlarging a device or forming devices, such as a sprayer style of water, and also regulation of gas-liquid contact time can also be performed easily. Since continuous running in a high gas-hydrate generated amount is possible, it is possible to manufacture gas-hydrate very efficiently. A method of introducing water into a generation tub continuously, and discharging water continuously from a generation tub as a desirable example of a method of forming air bubbles and a stream which counters in a generation tub, can be mentioned. In this case, as for water, it is preferred to introduce from a crowning or near a crowning a generation tub, and to discharge from a pars basilaris ossis occipitalis or near a pars basilaris ossis occipitalis a generation tub. If this method is adopted, while being able to form easily a stream which descends inside of a generation tub, it becomes easy by adjusting strength of a stream to control not to make air bubbles reach to a crowning of a generation tub. Therefore, sufficient gas-liquid contact time by stagnation of air bubbles is securable, and also a mechanism for recovery of gas in a generation tub crowning or circulation can be made simple, or it can omit. Although an entry site in particular of air bubbles is not limited, in order to increase gas-liquid contact using climbing power of air bubbles, introducing from the lower part of a generation tub is preferred.

[0010]In claim 1, said water ejecting means and said gas-hydrate ejecting means are provided in one, and an invention of a manufacturing installation of the gas-hydrate according to claim 2 is characterized by being what discharges gas-hydrate with water. Since it had composition which shares a water ejecting means and a gas-hydrate ejecting means according to this feature, gas-hydrate is easily recoverable in the state of a slurry by making gas-hydrate discharge using a stream. Simplification of a device can be attained by considering it as a mechanism which shares a gas-hydrate ejecting means and a water ejecting means. In this case, since extraction of generated gas-hydrate will become smooth if it has composition made to discharge from a pars basilaris ossis occipitalis or near a pars basilaris ossis occipitalis a generation tub, it is much more efficient.

[0011]An invention of a manufacturing installation of the gas-hydrate according to claim 3 has a cellular stagnation facilitator which extends gas-liquid contact time by urging stagnation of air bubbles to said generation tub in claim 1 or 2. Since contact time of vapor-liquid can be extended by a cellular stagnation facilitator according to this feature, gas-hydrate can be manufactured at higher efficiency. Here, a baffle etc. which establish a narrow diameter portion and an inclined wall which carry out a postscript as a cellular stagnation facilitator and which do not block a stream remarkably can be used.

[0012]An invention of a manufacturing installation of the gas-hydrate according to claim 4 is characterized by being what resembles a wall inclined so that said cellular stagnation facilitator might turn caudad and might be extended from a narrow diameter portion which was established in said generation tub, and where an inside diameter is short, and this narrow diameter portion, and is constituted more in claim 3. By adopting a narrow

diameter portion where an inside diameter is short, and a wall inclined so that it might turn caudad and might be extended from a narrow diameter portion as a cellular stagnation facilitator according to this feature, It becomes possible to suppress a rise of air bubbles and to promote stagnation, without barring a stream which air bubbles which went up will stagnate in a narrow space surrounded by inclined wall, and flows down inside of a tub as a result of the rate of flow in a narrow diameter portion becoming quick. and this cellular stagnation facilitator -- structure -- it is not necessary to simplify and to complicate an equipment configuration Although it is preferred to provide a narrow diameter portion near the crowning of a generation tub as a position which forms a cellular stagnation facilitator, unless a stream in a generation tub is barred, it is also possible to provide in other parts (it is near the central part of a long generation tub to length), and to provide in two or more parts in one generation tub.

[0013]An invention of a manufacturing installation of the gas-hydrate according to claim 5, While having further a tank which stores gas-hydrate discharged by said gas-hydrate ejecting means from a generation tub in any 1 paragraph of claim 1 to claim 4, A water cycle means to circulate water of aqueous phase separated within this tank into said generation tub via said water supplying means, gas which surfaced inside of said generation tub, and/or gas in said tank were collected, and a gas circulation means circulated into said generation tub via said gas supply means was formed. According to this feature, continuous operation is attained by having formed a gas circulation means to collect and circulate from a tank a water cycle means circulated into a generation tub, gas which surfaced inside of a generation tub, and/or gas in a tank, using effectively water and gas used as a raw material of gas-hydrate.

[0014]An invention of a manufacturing method of the gas-hydrate according to claim 6, While carrying out aeration of the material gas to water in a generation tub which is a manufacturing method of gas-hydrate which makes water and gas react under application of pressure, and makes gas-hydrate generate, and makes gas-hydrate generate, considering it as air bubbles and surfacing underwater, A stream which counters said air bubbles which surface was formed. According to this feature, the same operation effect as above-mentioned claim 1 is obtained. That is, it can become possible to make air bubbles stagnate in a generation tub, and to extend gas-liquid contact time, a dissolved amount of underwater material gas can be raised, and a generated amount of gas-hydrate can be made to increase substantially. And since it is the method of using a stream which counters air bubbles, gas-liquid contact time can be increased, without enlarging a device or forming devices, such as a sprayer style of water, and also regulation of gas-liquid contact time can also be performed easily. Since continuous running in a high gas-hydrate generated amount is possible, it is possible to manufacture gas-hydrate very efficiently.

[0015]In claim 6, an invention of a manufacturing method of the gas-hydrate according to claim 7 makes it accumulated according to said stream, and took out generated gas-hydrate out of a tub. Since according to this feature you make it accumulated using a stream and generated gas-hydrate was taken out out of a tub, while recovery of gas-hydrate becomes easy, gas-hydrate is recoverable by high concentration.

[0016]An invention of a manufacturing method of the gas-hydrate according to claim 8 promoted stagnation of air bubbles in a generation tub in claim 6 or 7 by a cellular stagnation facilitator formed in said generation tub. According to this feature, the same operation effect as above-mentioned claim 3 is obtained. Here, a baffle etc. can be used in the range which does not bar a stream in a generation tub besides the narrow diameter portion same as a cellular stagnation facilitator as what was indicated to above-mentioned claim 4, and an inclined wall.

[0017]In any 1 paragraph of claims 6-8, an invention of a manufacturing method of the gas-hydrate according to claim 9 controls the rate of flow of a cell diameter and water so that air bubbles carry out predetermined time stagnation into a generation tub. According to this feature, when the rate of flow of a cell diameter and water is controlled and air bubbles were made to carry out predetermined time stagnation into a generation tub, without enlarging a generation tub, sufficient gas-liquid contact time is secured and gas-hydrate can be manufactured efficiently. It becomes possible by adjusting holding time of air bubbles suitably to control particle diameter of gas-hydrate to generate in a desired size. Especially if holding time of air bubbles in a generation tub is time for gas-hydrate to fully generate, it is not limited, but it can be set up in about 1 to 10 minutes preferably 1 minute or more, for example.

[0018]

[Embodiment of the Invention]Hereafter, based on a drawing, this invention is explained in more detail. Drawing 1 is a drawing in which the outline of the gas-hydrate manufacturing installation 100 which is one embodiment of this invention is shown. This gas-hydrate manufacturing installation 100 is a continuous system manufacturing installation of gas-hydrate which has the generation tub 11, the water tank 13, the gas-hydrate tank 15, the water supply pump 17, and the extraction pump 19 as main composition. The kind of gas used as a raw material will not be limited especially if gas-hydrate is formed by predetermined pressure and temperature conditions, for example, it can mention methane, natural gas (mixed gas, such as methane, ethane, propane, and butane), carbon dioxide (carbon dioxide), etc.

[0019]Whole shape was carrying out longwise outline tubed, the crowning was equipped with the introduction means of water, and the generation tub 11 to which a gas-hydrate generation reaction is performed equipped the pars basilaris ossis occipitalis with the ejecting means of water, and is provided with the aeration mechanism 31 which emits the gas 53 to the lower part as air bubbles further. This generation tub 11 is the resisting pressure container provided with the jacket type heat exchanger 33 as a cooling method, flows out with the inflow 41 of brine, cools internal water and gas by 42, and it is constituted so that the temperature and the pressure in a tub can be maintained in the state of having been suitable for the generation condition of gas-hydrate. Although the generation tub 11 is equipped with the jacket type heat exchanger 33 as a cooling method in drawing 1, When maintainable to the temperature which needs the inside of the generation tub 11 for gas-hydrate generation, For example, the water 51 is cooled and supplied from the water tank 13 provided with the cooling method (coil type heat exchange mechanism 35) to a temperature required for generation of gas-hydrate, And it

is not necessary to prepare said jacket type heat exchanger 33 for a case so that it may flow out of the inside of the generation tub 11 comparatively for a short time at the generation tub 11.

[0020]Drawing 2 is a drawing in which an example of the shape of the generation tub 11 is shown, and after [expedient] explaining here, it has expanded and indicated breadth. As for the whole shape of the generation tub 11, it is preferred to use the shape of a longwise approximately cartridge so that it may illustrate to drawing 2. It not only becomes easy to secure gas-liquid contact time, but by making the generation tub 11 into long picture shape perpendicularly, it becomes easy to make a uniform stream form in the generation tub 11. Namely, in order to suppress a motion to the horizontal direction of the air bubbles which go up the inside of the generation tub 11 as much as possible (getting it blocked and making horizontal cellular distribution uniform) and to control a motion of the perpendicular direction further, it becomes important to form a uniform stream in the generation tub 11, but. It is because it becomes easy to realize a uniform stream by making the generation tub 11 into the shape of a longwise cartridge. But if formation of a stream uniform in the generation tub 11 is possible, it is also possible to adopt other shape.

[0021]The cellular stagnation part 112 of predetermined length with the wall inclined so that this generation tub 11 might be extended caudad towards near a crowning from the short narrow diameter portion 111 and this narrow diameter portion 111 of an inside diameter, The major diameter 113 caudad formed in tubed with predetermined length from the lower end of this cellular stagnation part 112, the gas-hydrate accumulation part 114 of the predetermined length inclined so that it might strangulate toward a pars basilaris ossis occipitalis from the lower end of this major diameter 113, and **, ** and others As a result of the rate's of flow becoming quick by using such shape compared with the major diameter 113 in the narrow narrow diameter portion 111 and the cellular stagnation part 112 of an inside diameter, it becomes possible to block passage of the air bubbles which gather as it rises to surface, and a climbing speed increases, and to secure sufficient holding time. That is, the wall in which the narrow diameter portion 111 and the cellular stagnation part 112 inclined functions as a cellular stagnation facilitator for urging stagnation of air bubbles and lengthening gas-liquid contact time. A cellular stagnation facilitator will not be restricted to the above-mentioned composition, if the holding time of air bubbles can be extended without barring the stream which flows down the inside of the generation tub 11.

[0022]In order to obtain the uniform stream in the generation tub 11, and diffusion of air bubbles, For example, the ratio (ratio of length to diameter) of the inside diameter (D) of the major diameter 113 and the length (L) from the aeration part (aeration mechanism 31) located in the lower end vicinity of the major diameter 113 to the upper bed of the major diameter 113 is made about into five to ten, It is preferred to set the ratio (l/d) of the inside diameter (d) of the narrow diameter portion 111 and the length (l) of the cellular stagnation part 112 about to ten to 20.

[0023]Drawing 3 is a drawing in which another example of the generation tub 11 is shown, and it can promote stagnation of air bubbles, securing diffusion of a uniform stream and air bubbles, even if it uses such shape.

[0024]Although a stirring means may be provided in the generation tub 11, even if it does not establish a stirring means, the water 51 and the gas 53 are fully mixed with aeration by the stirring effect by a stream. Therefore, it is possible to omit stirring power and manufacture with energy saving is realized.

[0025]The water tank 13, the water supply pump 17, and the water supply piping 61 constitute the water supplying means, and they introduce it continuously to the generation tub 11, pressurizing the water 51 to specified pressure. Since it is provided with the coil-in-box cooler 35, the water tank 13 can cool beforehand the water 51 which flows out with the inflow 43 of brine and is supplied to the generation tub 11 by 44 to prescribed temperature, prevents the rise in heat in the generation tub 11, and is raising the production efficiency of gas-hydrate. Since the water 51 cooled also when the circulation reuse of the water 51 from the gas-hydrate tank 15 was carried out so that it may mention later can be used, it is advantageous.

[0026]The gas-hydrate tank 15 is provided with the jacket type heat exchanger 37 for gas-hydrate incubation outside, and by cooling by the inflow 45 of brine, and the outflow 46, it is constituted so that the degree of tub internal temperature can be kept constant.

[0027]Although it is full of the water 51 introduced from the crowning of the generation tub 11 with specified pressure in a tub, it will flow down the inside of a tub by operating the extraction pump 19 as a water ejecting means, and discharging from a pars basilaris ossis occipitalis, forming the flow field of a predetermined speed. The flow of this water 51 is formed as the air bubbles which go up underwater by lift, and a flow which counters so that it may mention later. the horizontal section of the generation tub 11 -- mostly, in the whole, the water 51 is supplied so that this countercurrent flow may arise.

[0028]Although it is preferred to be able to adjust to a predetermined speed and to set up according to a cell diameter by introduction and the discharge of the water 51 as for the flowing-down speed of the water 51 in the generation tub 11, it can be made into the range of 0.1 - 3 m/s, for example.

[0029]The gas 53 is inserted into the generation tub 11 from the lower part of the generation tub 11 via the gas supplying pipelines 62 from the supply source which is not illustrated, and is underwater emitted as air bubbles from the aeration mechanism 31. Since the downward current of the prescribed speed is formed downward from the top so that air bubbles may be countered in a tub, the climbing speed of air bubbles becomes remarkably slow compared with the case where there is no downward current, or has a rise barred although the emitted air bubbles go up the inside of the generation tub 11 according to the climbing power. The gas in air bubbles follows on being consumed as a hydrate, and the lift of air bubbles also becomes small. As a result, the holding time within the generation tub 11 of air bubbles becomes long, the dissolved amount of the gas

53 increases, and the generation reaction (hydration reaction) of gas-hydrate advances efficiently. As for the holding time of air bubbles, although it changes according to the downward rate of flow of a cell diameter or water, in order to make sufficient gas-hydrate generation reaction perform, it is preferred to set up, as it has been about 1 to 10 minutes, for example. It is also possible by adjusting the holding time of these air bubbles to control the particle diameter of the gas-hydrate to generate in arbitrary sizes. For example, by making flowing-down speed of water quick and shortening holding time of the air bubbles within a generation tub, Growth time of gas-hydrate can be shortened, the hydrate of small particle diameter can be manufactured, or by making flowing-down speed of water late and lengthening holding time of the air bubbles within a generation tub conversely, growth time of gas-hydrate can be lengthened and the hydrate of large particle diameter can be manufactured.

[0030]Although the gas 53 is based also on the flowing-down speed of water, or the size of air bubbles, most is discharged from the pars basilaris ossis occipitalis of the generation tub 11 with a stream, and it is moved to the gas-hydrate tank 15. When the gas 53 goes up the generation tub 11 and a crowning is reached, via the 1st piping 66 for gas circulation, again, from the gas supplying pipelines 62, it is introduced in the generation tub 11 and reuse is achieved. In order to discharge the efficient gas 53 from generation tub 11 crowning, a pump may be installed in the 1st piping 66 for gas circulation if needed.

[0031]According to contact, the predetermined pressure, and temperature conditions of the above gas 53 and the water 51, the gas-hydrate 55 generates within the generation tub 11. The generated gas-hydrate 55 has specific gravity (for example, methane hydrate 0.915 g/cm^3) smaller than water, properly speaking, there is also a thing with the character which surfaces underwater, but. Even in this case, in this invention manufacturing installation 100, the gas-hydrate accumulation part 114 (refer to drawing 2 and drawing 3) near a pars basilaris ossis occipitalis is automatically piled up according to the stream in the generation tub 11, being discharged by operation of the extraction pump 19 as which a role of a gas-hydrate ejecting means also serves with the water 51 from a pars basilaris ossis occipitalis -- the piping 63 for gas-hydrate recovery -- ****** -- having -- it is stored in the gas-hydrate tank 15. Thus, while simplification of a device is attained by leading the water 51 and the gas-hydrate 55 to the gas-hydrate tank 15 in the same course, the gas-hydrate 55 of a fluid high slurry regime can be manufactured continuously and at high speed. In this embodiment, in order to transport the water 51 and the gas-hydrate 55 in the same course, discharge from the generation tub 11 is performed from the same part of a pars basilaris ossis occipitalis, but it may discharge separately like a 2nd embodiment that carries out a postscript. The part which discharges the water 51 or the gas-hydrate 55 is a range which does not restrict to the pars basilaris ossis occipitalis of the generation tub 11, and does not spoil the effect of this invention, and the composition discharged from other parts is possible for it.

[0032]Within the gas-hydrate tank 15, since the gas-hydrate 55 and the water 51 which were generated separate in layers, the lower layer water 51 is again returned to the water supply tub 13 via the 1st piping 64 for water cycles by opening of the valve 39, and is

reused. water -- ****** -- having -- **** -- when the gas-hydrate 55 decomposes, the gas 53 which stagnated in the upper part of the gas-hydrate tank 15 is returned and reused via the 2nd piping 65 for gas circulation by the piping 62 for gas supply. By this, continuous running of the gas-hydrate manufacturing installation 100 which used water and gas effectively becomes possible.

[0033]Drawing 4 is a drawing in which the outline composition of the gas-hydrate manufacturing installation 101 of a 2nd embodiment of this invention is shown, and has established separately the water ejecting means and the gas-hydrate ejecting means here.

[0034]Namely, the gas-hydrate 55 accumulated on the gas-hydrate accumulation part 114 (refer to drawing 2 and drawing 3) near a pars basilaris ossis occipitalis according to the stream in the generation tub 11, being discharged by operation of the extraction pump 19 from a flank -- the piping 63 for gas-hydrate recovery -- ****** -- having -- it is stored in the gas-hydrate tank 15. On the other hand, the water 51 which flowed down the inside of the generation tub 11 is discharged from the pars basilaris ossis occipitalis of the generation tub 11 from an outlet other than the outlet of the gas-hydrate 55, and a reuse loop is sent and carried out to the water tank 13 by the 2nd piping 67 for water cycles. Thus, while being able to store the gas-hydrate 55 of the state where concentration is comparatively high in the gas-hydrate tank 15 by transporting the generation gas-hydrate 55 and the water 51 by alternative pathway, Since the greater part of a lot of circulating water is performed via the 2nd piping 67 for water cycles that carries out direct continuation to the water tank 13, it is efficient. Since other composition in drawing 4 is the same as that of drawing 1, it gives the same numerals to the same composition, and omits explanation.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The drawing with which explanation of the gas-hydrate manufacturing installation of one embodiment of this invention is presented.

[Drawing 2]The drawing explaining an example of the shape of a generation tub.

[Drawing 3]The drawing explaining other examples of the shape of a generation tub.

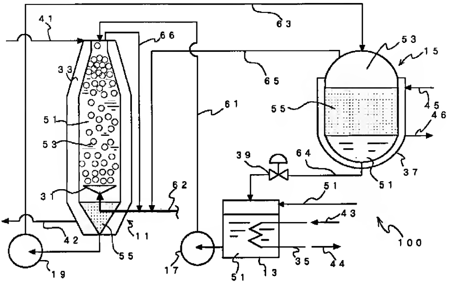
[Drawing 4]The drawing with which explanation of the gas-hydrate manufacturing installation of another embodiment of this invention is presented.

[Description of Notations]
11 Generation tub
13 Water tank

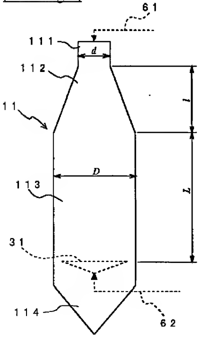
15 Gas-hydrate tank
17 Water supply pump
19 Extraction pump
31 Aeration mechanism
33 Jacket type heat exchanger
35 Coil-in-box cooler
37 Jacket type heat exchanger
39 Valve
41, 43, and 45 Inflow brine
42, 44, and 46 Outflow brine
51 Water
53 Gas
55 Gas-hydrate
61 Piping for water supplies
62 Piping for gas supply
63 Piping for gas-hydrate recovery
64 1st piping for water cycles
65 2nd piping for gas circulation
66 1st piping for gas circulation
67 2nd piping for water cycles
100 Gas-hydrate manufacturing installation
101 Gas-hydrate manufacturing installation
111 Narrow diameter portion
112 Cellular stagnation part
113 Major diameter
114 Gas-hydrate accumulation part

DRAWINGS

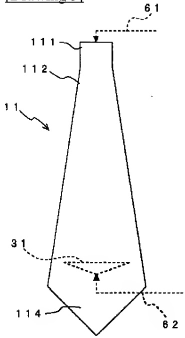
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Drawing 4]